

Jan. 6, 1942.

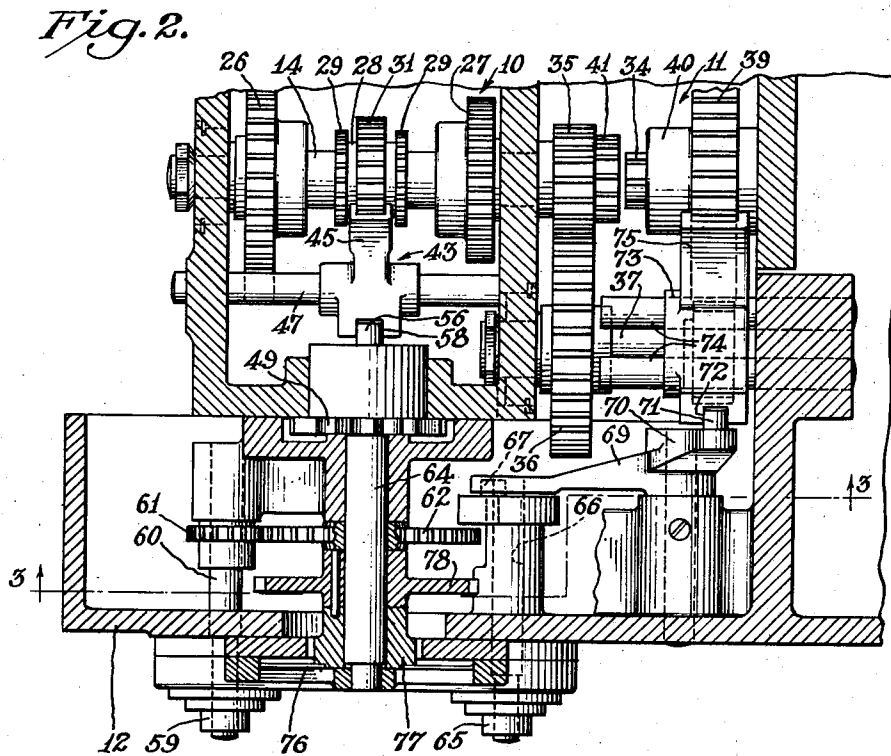
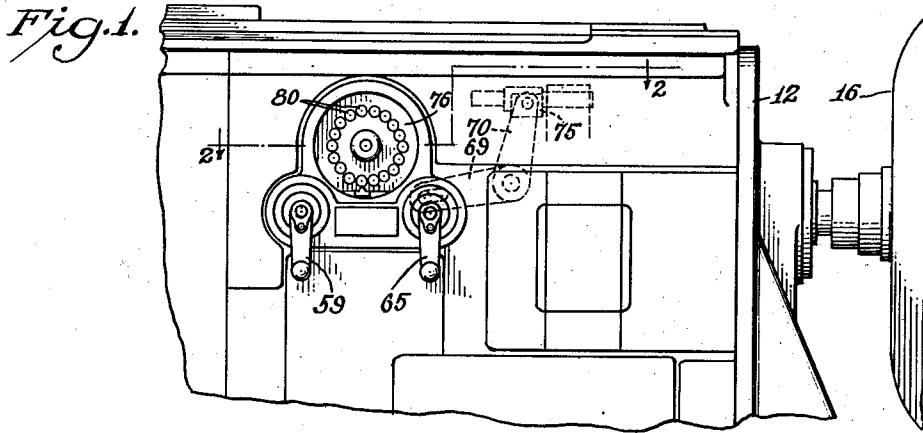
G. H. SCHURGER

2,269,290

SPEED-CHANGE MECHANISM

Filed Feb. 26, 1940

3 Sheets-Sheet 1



Inventor
Garner H. Schurger
BY

Parker, Carlson, Pitman & Hotchard
Attorneys.

Jan. 6, 1942.

G. H. SCHURGER

2,269,290

SPEED-CHANGE MECHANISM

Filed Feb. 26, 1940

3 Sheets-Sheet 2

Fig. 3.

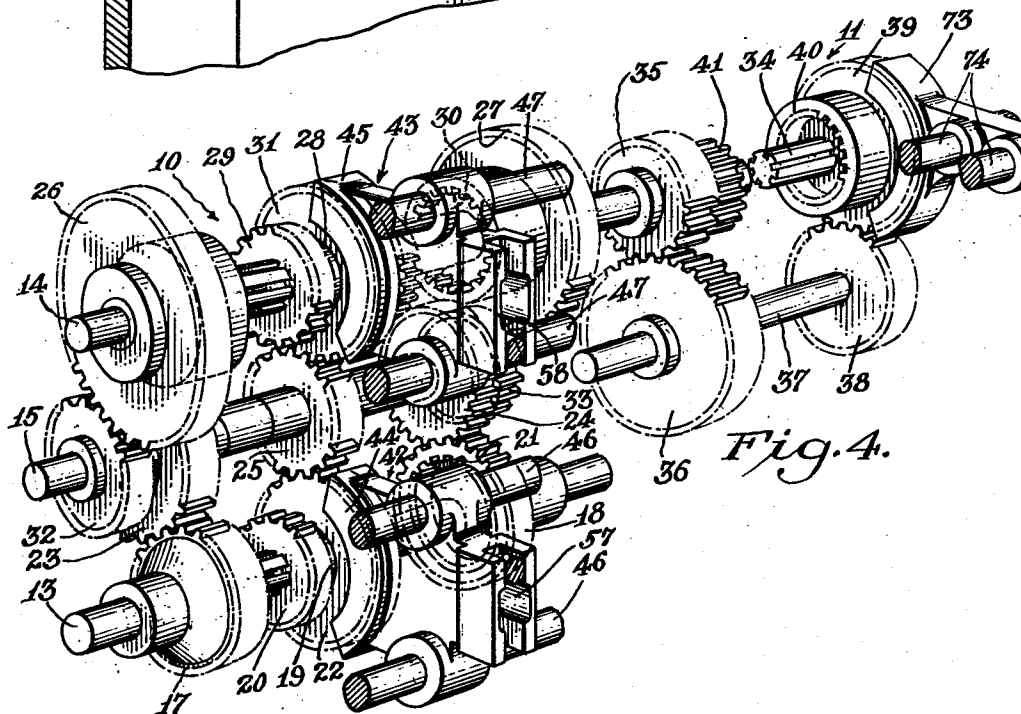
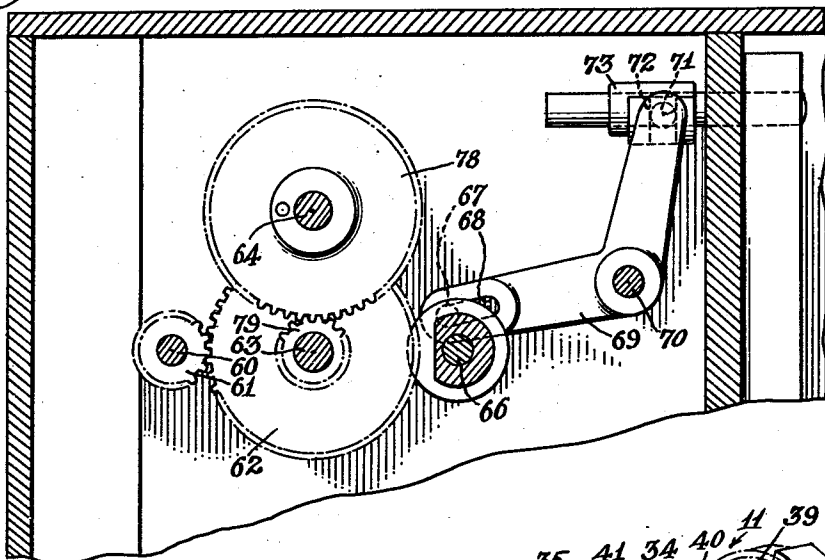


Fig. 4.

Inventor
Garner H. Schurger
BY

Parkes, Carlson, Rogers & Hubbard
Attorneys.

Jan. 6, 1942.

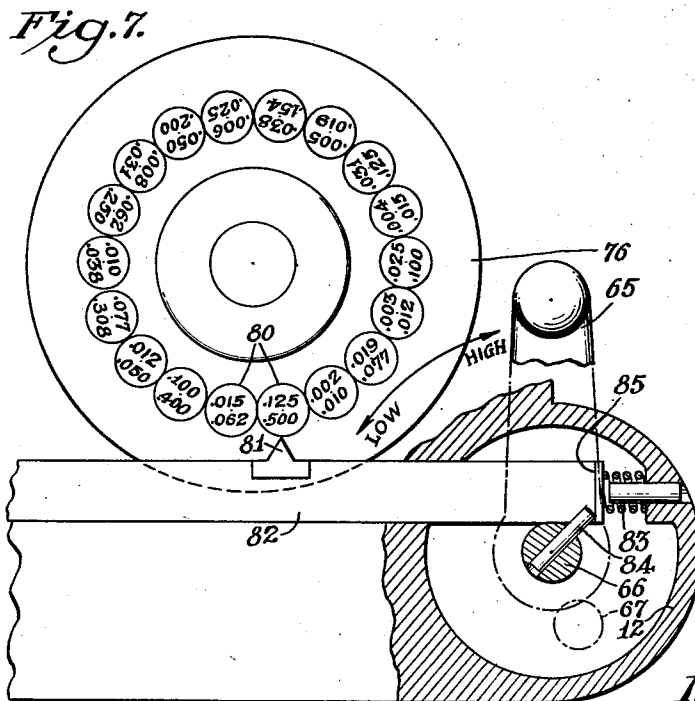
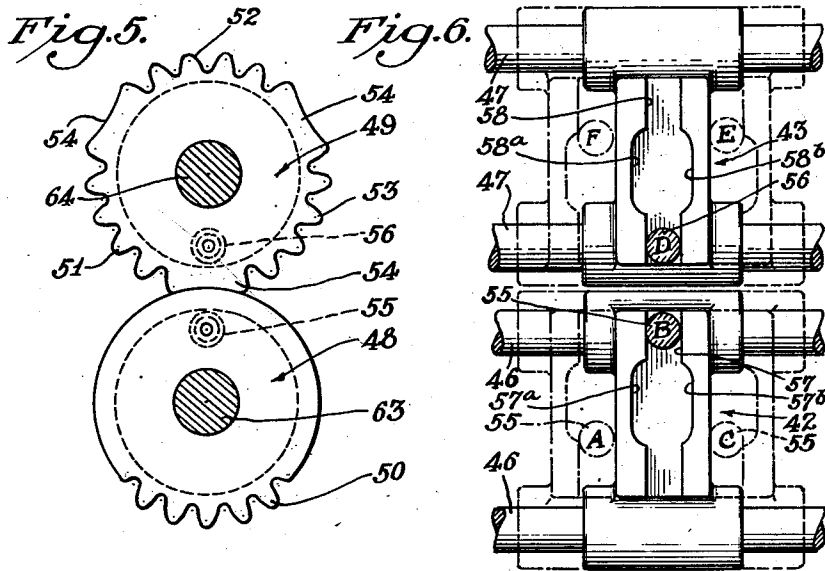
G. H. SCHURGER

2,269,290

SPEED-CHANGE MECHANISM

Filed Feb. 26, 1940

3 Sheets-Sheet 3



Inventor
Garner H. Schurger
BY

Parker, Carlson, Pitzer & Hubbard
Attorneys.

UNITED STATES PATENT OFFICE

2,269,290

SPEED-CHANGE MECHANISM

Garner H. Schurger, Fond du Lac, Wis., assignor
to Giddings & Lewis Machine Tool Co., Fond du
Lac, Wis.

Application February 26, 1940, Serial No. 320,805

2 Claims. (Cl. 74—333)

The present invention relates to improvements in speed-change mechanisms, adapted particularly for machine tools. In general, the present invention consists an improvement upon the mechanism disclosed in Keith F. Gallimore Patent No. 2,106,731, issued February 1, 1938.

One object of the present invention is to provide a speed-change mechanism having a simplified and inexpensive adjusting mechanism of novel form. In a large measure, this simplification is accomplished by utilizing cooperating cam parts fixed directly on and rigid with, respectively, a set of intermittent gears in the actuator and a corresponding set of shifter shoes, which engage the shiftable gear elements of the speed-change gearing. By this means I have eliminated the relatively expensive and complicated lever and rock shaft connections heretofore used in connecting such gear and shifter shoe elements as shown, for example, in the Gallimore patent referred to above.

Another object is to provide a speed-change mechanism embodying a novel form of crank-type adjusting means whose manipulation is materially simplified by virtue of the fact that a full revolution of the hand crank is used for each successive speed setting, thereby also simplifying the apparatus as a whole through the elimination of the detents or the like otherwise necessary to define the successive fractional revolution positions of the hand crank.

The invention also resides in various structural improvements and innovations, by means of which simple and effectual operation are combined with low cost and ruggedness of construction.

Further objects and advantages of the invention will become apparent as the following description proceeds, taken in connection with the accompanying drawings, in which:

Figure 1 is a fragmentary front elevation of a tool head containing a speed-change gearing embodying the present invention.

Fig. 2 is an enlarged horizontal sectional view along the line 2—2 in Fig. 1.

Fig. 3 is a vertical sectional view along the line 3—3 in Fig. 2.

Fig. 4 is a general perspective view of the gearing.

Fig. 5 is a detail view of the intermittent gears included in the speed-change actuator.

Fig. 6 is an enlarged outer face view of the actuator shoes.

Fig. 7 is a detail view, partially in section, of

the dial mechanism for the speed-change gearing.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring more particularly to the drawings, the speed-change mechanism may be interposed in any desired drive, as, for example, in an axial feed spindle drive, such as that disclosed in the copending application of Keith F. Gallimore, Serial No. 320,853, filed February 26, 1940, and may, in its broadest aspects, be adapted to afford any desired number of selected speeds.

In the present instance the mechanism as illustrated as affording eighteen different speed settings. For this purpose it includes (see Fig. 4) series connected nine and two-speed gearings, designated generally as 10 and 11, respectively, the nine-speed gearing comprising in effect two three-speed gearings. These gearings may be enclosed in a suitable casing 12 (Fig. 1) which has been shown herein as a portion of a head-stock or movable tool head.

The nine-speed gearing 10 includes (Fig. 4 and see also Fig. 2) an inlet shaft 13, an outlet shaft 14, and an intermediate shaft 15, all of said shafts being suitably journaled in the casing 12. The inlet shaft 13 is adapted to be connected to a suitable source of power, as, for example, to an electric motor 16 (Fig. 1) through suitable intermediate connections (not shown). The outlet shaft 14 is, on the other hand, connected to the two-speed gearing 11 and the latter is in turn connected to feed a tool spindle (not shown) in the tool head casing 12.

On the nine-speed unit inlet shaft 13 (Fig. 4) are loosely journaled two end gears 17 and 18 adapted to be alternatively coupled to the shaft 13 by a centrally located clutch sleeve 19 axially splined on the shaft. This clutch sleeve has on its ends external clutch elements 20 positioned for alternative engagement with complementary internal clutch elements 21 fashioned in the inner faces of the end gears 17 and 18. Integral with the sleeve 19 is a third gear 22. Meshing with the end gears 17 and 18 are end gears 23 and 24 fast on the intermediate shaft 15 while a third or central gear 25, also fast on this inter-

mediate shaft, is arranged to mesh with the gear 22 when the clutch sleeve 19 is in its intermediate position as shown. The clutch sleeve 19, with its gear 22, thus constitutes a shiftable clutch unit having three different operative positions of adjustment. First, if the sleeve 19 is in its intermediate position, as shown, the inlet shaft 13 is connected to the intermediate shaft 15 through the meshing gears 22 and 25. Second, when the sleeve 19 is shifted to the left to couple the gear 17 to the inlet shaft 13, this latter shaft is connected to the intermediate shaft through gears 17 and 23. Third, when the clutch sleeve is shifted to the right to engage the corresponding clutch elements the shafts 13 and 15 are connected through the gears 18 and 24. These various gear combinations have different speed ratios so that the intermediate shaft 15 may be driven selectively at any one of three different speeds.

Similarly, on the nine-speed unit outlet shaft 14 are loosely journaled two end gears 26 and 27, adapted to be alternatively coupled to the shaft by a centrally located clutch sleeve 28 axially splined on the shaft 14. This clutch sleeve has external end clutch elements 29 alternatively engageable with complementary internal clutch elements 30 on the respective end gears 26 and 27. Additionally, a third or central gear 31 is fixed on the sleeve 28 and is adapted to mesh with the central gear 25 on the intermediate shaft 15 when the sleeve 28 is in its central or vertical position. The end gears 26 and 27 mesh with gears 32 and 33 fixed to the gears 23 and 24, respectively, of the intermediate shaft. Accordingly, when the clutch sleeve 28 is in its central position shown the gears 25 and 31 are in mesh to complete a drive from the intermediate shaft 15 to the outlet shaft 14. On the other hand when the sleeve 28 is shifted to the left to couple the gear 26 to the shaft 14, the drive from the shaft 15 to shaft 14 is completed through gears 32 and 26. Similarly, coupling of the gear 27 to the shaft 14 by the sleeve 28 completes a drive connection between the shafts 15 and 14 through gears 33 and 27. As before, the ratios between the three alternatively available pairs of gears are different so as to afford three different speed ratios between the shafts 15 and 14.

By adjusting each of the clutch units or sleeves 19 and 28 successively into positions of progressively different speed ratios, and adjusting one unit, for example, the unit 19, through all of its positions for each position of the other unit, the outlet shaft 14 may be driven at nine progressively different speeds.

The two-speed gearing 11 (Figs. 2 and 4) is connected to the nine-speed outlet shaft 14 and includes its own outlet shaft 34. On the shaft 14 is fixed a pinion 35 meshing with a gear 36 fast on a shaft 37. Also fast on this shaft 37 is a pinion 38 meshing with gear 39 splined on the outlet shaft 34. Rigid with this latter gear 39 is an internal end clutch element 40 positioned to engage a complementary external clutch element 41, fixed on the pinion 35, when the gear and clutch unit 39-40 is shifted to the left. It will thus be seen that a high speed connection may be completed directly between the shafts 14 and 34 through the clutch elements 41, 40 or alternatively a low speed connection may be completed between these shafts through the pairs of elements 35, 36 and 38, 39.

In order to shift the clutch units 19 and 28 of the nine-speed gearing, two shifters 42 and

43 are utilized (Fig. 4). These shifters include arcuate shoe portions 44 and 45 respectively dimensioned to engage the lateral sides of the corresponding gear elements 22 and 31 of the respective clutch units. The lower shifter 42 is mounted for rectilinear sliding movement, along a path paralleling that of the inlet shaft 13, by a pair of vertically spaced guide rods 46, while the upper shifter 43 is similarly mounted for rectilinear movement by a pair of guide rods 47. As the shifters 42 and 43 are moved along the guide rods the associated clutch units are moved correspondingly to their three successive positions of adjustment described above.

For the sake of maximum simplicity and compactness of construction, cooperating cam parts are fixed directly on and rigid with the shifters 42, 43 and a corresponding pair of intermittent gears 48 and 49 (Fig. 5) which are utilized in actuating these shifters. The lower gear 48, which is the driving gear of the pair, has a toothed sector 50 extending through 120 degrees and adapted to mesh successively with three similar toothed sectors 51, 52 and 53 on the gear 49. Abutments 54 between the toothed sectors 51, 52 and 53 on the gear 49 are movable selectively into engagement with the untoothed portion of the gear 48 to lock the gear 49 in fixed position during the two-thirds of each revolution of the gear 48 in which its toothed sector 50 is out of engagement with the gear 49. Thus the gear 49 is advanced one-third of a revolution for each full revolution of the cooperating intermittent gear 48 and is locked in position during the periods of dwell between its successive actuations.

In the cam means for connecting the shifters 42, 43 with the gears 48, 49, crank pins 55 and 56 are fixed to the inner faces of the respective gears (Figs. 2 and 5). The pin 55 is located diametrically opposite the tooth sector 50 while the pin 56 is located on the radial center line of one of the abutments 54. The intermittent gears 48, 49 are located directly opposite the outer faces of the shifters 42 and 43, respectively, so that the crank pins 55 and 56 project into corresponding vertical cam grooves 57 and 58 fashioned in the outer faces of the shifters (see Figs. 2, 4 and 6). Consequently, as the intermittent gear 48 is rotated in a clockwise direction the pin 55 will occupy the three successive positions designated as A, B and C in Fig. 6, thereby moving the shifter 42 to its three successive corresponding positions for the clutch unit 19. Similarly, as the second intermittent gear 49 moves in a counterclockwise direction its crank pin 56 occupies successively the positions designated as D, E, and F in Fig. 6 to move the shifter 43 to its corresponding three positions for the other clutch unit 28.

To prevent overtravel of the shifter 42 as the pin 55 moves between positions A and B a recess 57^a is fashioned in the side of the vertical cam groove 57 and to prevent overtravel in the opposite direction a similar recess 57^b is formed at the right hand side of the cam groove (Fig. 6). Corresponding recesses 58^a and 58^b in the sides of the cam groove 58 in the upper shifter 43 prevent overtravel of this shifter in the same manner.

To rotate the first intermittent gear 48, and thereby move the other gear 49 and the shifters 42 and 43 in timed relation, a hand crank 59 is provided on the front of the casing 12 (Figs. 1 and 2). This hand crank is fixed on the forward end of a rotatably journaled shaft 60 having

fixed on it a pinion 61. This pinion meshes with a gear 62 (see also Fig. 3) fast on a shaft 63, to the inner end of which is fixed the first intermittent gear 48. The ratio between the pinion 61 and gear 62 is one to three so that for each full revolution of the hand crank 59 the intermittent gear 48 will be moved through one-third of a revolution. In other words, each full revolution of the hand crank 59 shifts the crank pin 55 on the gear 48 through 120 degrees so that the engaged shifter 42 is advanced one step in its series of three steps or positions for setting the gear unit 19. The second or driven intermittent gear 49 is in turn loosely journaled on the inner end of a shaft 64 (Fig. 2) located above the shaft 63 (see Fig. 3) and is, of course, driven from the first intermittent gear 48. Thus nine successive full revolutions of the hand crank 59 will move the shiftable clutch units 19 and 28 of the nine-speed gearing to their nine successive settings. Since a full revolution of the hand crank is used for each step in the setting, the device is very simple to manipulate and no detents or the like are required to define fractional revolution settings for the hand crank.

In the case of the two-speed gearing 11, an adjacent hand crank 65 is provided on the front of the casing 12 for changing its setting (Fig. 1). This hand crank is fixed on the forward end of a shaft 66 (Fig. 2) suitably journaled in the casing and carrying on its inner end an eccentrically located crank pin 67 (see also Fig. 3). This crank pin is received in a longitudinal slot 68 fashioned in the lower arm of a bell crank 69 pivoted at 70. On the outer end of the upper bell crank arm is fixed a second crank pin 71 received in a complementary slot 72 in a shifter 73. This shifter is supported for rectilinear sliding movement on a pair of horizontal guide rods 74 and embodies an arcuate shoe 75 embracing the axially shiftable gear 39 (see also Fig. 4). In the position shown in Figs. 2, 3 and 4 the gear 39 is positioned to mesh with the gear 38 for the low speed setting of the two-speed gearing 11. Upon oscillating the hand crank 65 in a clockwise direction from the position of Fig. 1 to that of Fig. 7, the bell crank 69 is oscillated counter-clockwise and the shifter 73 is moved to the left, thereby pulling the gear 39 out of mesh with the gear 38 and engaging the clutch elements 40, 41 to complete the high speed connection for the two-speed gearing and in which the shafts 14 and 34 are directly coupled. To restore the gearing to its low speed setting the hand crank is, of course, oscillated in the opposite direction to its initial position.

A simplified and improved form of visual indicator means has been provided for showing at all times the composite setting of the nine and two-speed gearings 10 and 11. For this purpose, an open face dial 76 (Figs. 1, 2 and 7) is fixed to a sleeve 77 on the shaft 64. This sleeve is, in turn pinned to a gear 78 meshing with a pinion 79 fixed on the shaft 63 (Fig. 3). The ratio of the pinion 79 to the gear 78 is one to three so that for each full revolution of the hand crank 59 the dial 76 will be advanced one-ninth of a revolution. On the face of the dial 76 are eighteen indicia 80 arranged in pairs and in a circular series. Upon each advance of one-ninth of a revolution for the dial 76 a corresponding pair of these indicia 80 will be presented to a pointer 81.

In the present instance the indicia 80 (see Fig. 7) show spindle feed rates in terms of inches

per revolution. Each of the indicia 80 contains two figures to show the corresponding feed speeds for two spindles, as for example a main spindle and an auxiliary spindle in the machine, and which are adapted to be fed through the medium of single drive including the speed-change gearings 10 and 11. The outer circle of figures (made up of the outermost figures in each of the indicia 80) shows the feed rates for one spindle and the inner circle those for the other spindle. Thus the operator can easily, and simultaneously, read the feed rate setting for both spindles from the selected one of the indicia 80.

The pointer 81 is shifted in accordance with the setting of the two-speed gearing 11 so as to indicate which of the two indicia 80 presented by the dial 76 should be read by the operator. For this purpose the pointer 81 is fixed on an axially movable slider 82 which is yieldably urged to the left (Fig. 7) by a compression spring 83. Projecting from the shaft 66 which carries the hand crank 65 is a pin 84 arranged to engage an abutment 85 on the slider 82. When the hand crank 65 is positioned for the high speed setting of the two-speed gearing (as shown in Fig. 7), the pin 84 engages the abutment 85 and thrusts the slider to the right so that the pointer 81 registers with the right hand one of the indicia present at the bottom of the dial 76. Similarly, when the hand crank 65 is shifted to its low speed position (shown in Fig. 1) the pin 84 is oscillated away from the abutment 85 so that the spring 83 moves the slider endwise to bring the pointer 81 into registry with the other of the presented pair of indicia 80.

From the foregoing it will be seen that a speed-change mechanism has been provided which is characterized particularly by its compactness and small number of parts despite the very wide variety of speed settings afforded. Moreover, the manipulation of the mechanism by the two hand cranks 59 and 65 is very simple, particularly in view of the use of a full revolution of the hand crank 59 for each step in setting the nine-speed unit.

I claim as my invention:

1. A speed-change mechanism comprising, in combination, a speed-change gearing having two selectively shiftable gear elements movable in adjacent parallel paths, individual shifter shoes engaged with respective ones of said elements, means slidably supporting said shoes for rectilinear movement in paths paralleling the paths of movement of said elements, each of said shoes having three positions in its path of movement for corresponding settings of the speed-change gearing, said shoes presenting outer faces disposed side by side with cam grooves therein, disposed at right angles to the direction of shoe movement, a first intermittent gear having three gear sectors extending through 120 degrees, a second intermittent gear having a single gear sector extending through 120 degrees for selective meshing engagement with the first mentioned sectors to rotate said first gear through one-third of a revolution for each complete revolution of said second gear, said gears being arranged opposite corresponding ones of said shoes and each having an eccentrically located crank pin thereon projecting into the cam groove in the corresponding shoe, and means for rotating said second gear.

2. A speed-change mechanism comprising, in combination, a speed-change gearing having two

selectively shiftable gear elements, individual shifter shoes engaged with respective ones of said elements and disposed for movement alternately to one side or the other of a central position, first, second and third shafts arranged in parallel relation and projecting laterally away from said shoes at right angles to the direction of movement thereof, a first intermittent gear on said first shaft having three gear sectors extending through 120 degrees, a second intermittent gear fixed on said second shaft and having a single gear sector extending through 120 degrees for selective meshing engagement with the first mentioned sectors to rotate said first gear through one-third of a revolution for each complete revolution of said second gear, means for

connecting said gears in operative relation with respective ones of said shoes to shift the corresponding shoe to a different one of its three positions for each one-third of a revolution for its associated gear, a hand crank fixed on said third shaft, means forming a one-to-three gear connection between said second and third shafts to rotate said second intermittent gear one-third of a revolution for each full revolution of the hand crank, an indicator dial on said first shaft, and means forming a one-to-three gear connection between said second shaft and said dial to rotate the latter through one-ninth of a revolution for each full revolution of the hand crank.

GARNER H. SCHURGER.